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Varying Exhaust Stack Discharge Velocity to Improve Energy Efficiency

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Benefits of Varying Stack Discharge Velocity

- Reduction in energy usage
- Reduction in both interior and exterior radiated noise
- Improve system reliability and control stability

Current Industry Standards

ANSI/AIHA Z9.5-1992, Section 2.4

- Vertical discharge 10’ above adjacent roof lines
- Discharge velocity of 3000 fpm

Current Industry Standards (continued)

ASHRAE Applications

Handbook – 2003, Chapter 14

- Separation between intake and exhaust
- Stack Height
- Stack Height plus momentum

Current Industry Standards (continued)

- CFD or wind tunnel modeling recommended
- Increase effective stack height by increasing effluent momentum
- Acceptable dilution is 3 ppm

Factors Affecting Airflow Around Buildings

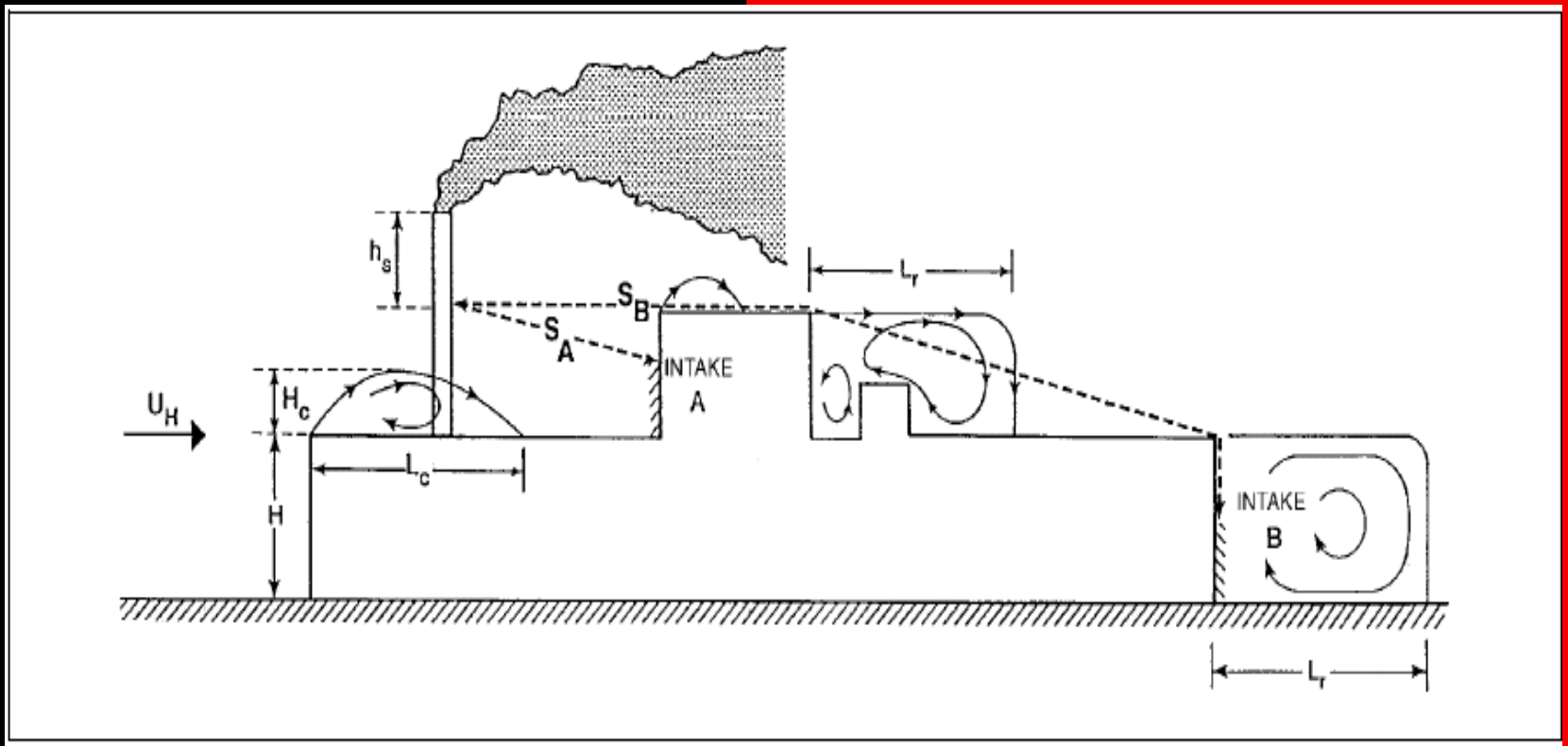

Fig. 3 Flow Recirculation Regions and Exhaust-to-Intake Stretched-String Distances
(Wilson 1982)

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Case Study
Government Laboratory Facility

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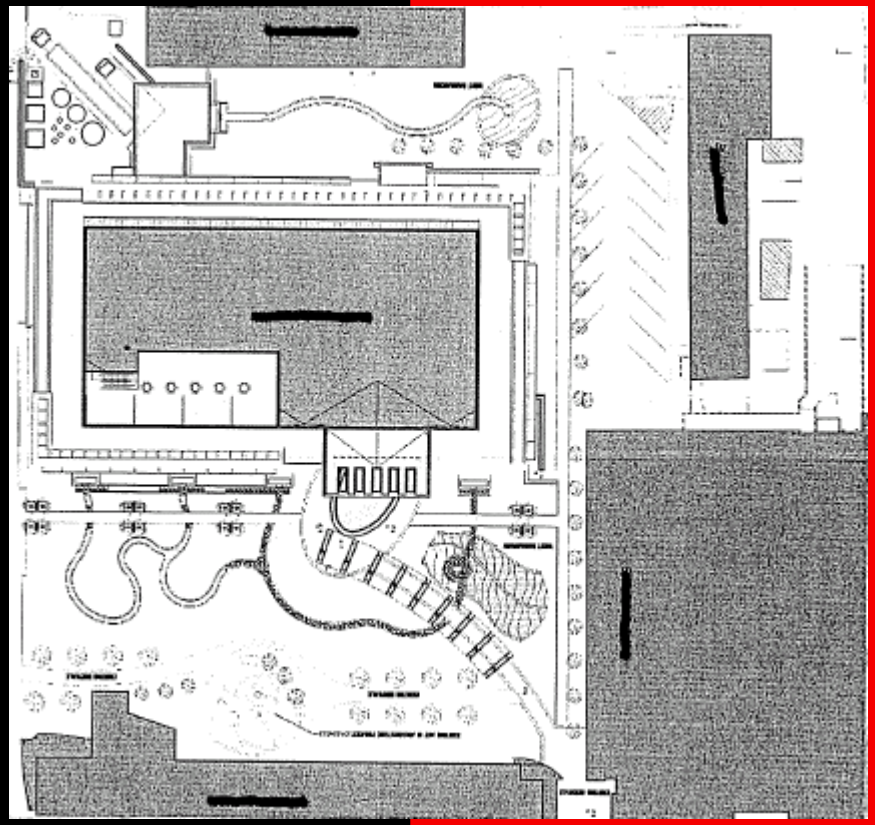
Site Plan



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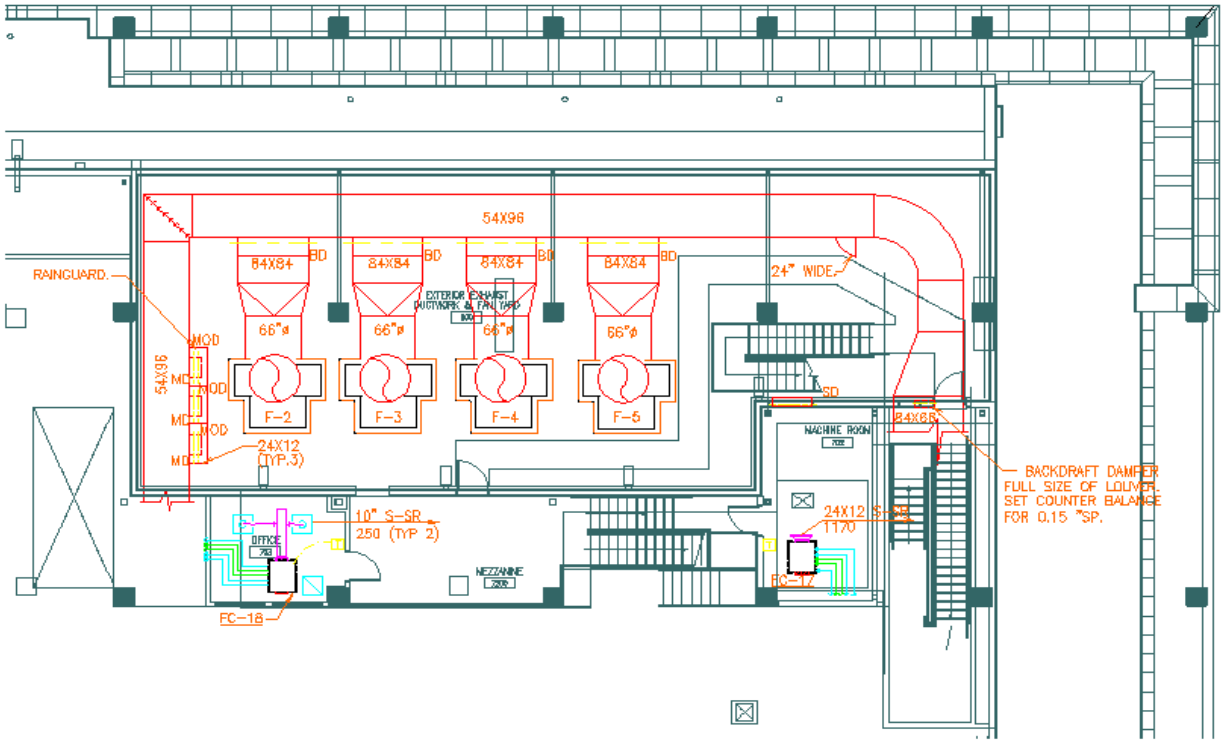
Laboratory Exhaust System



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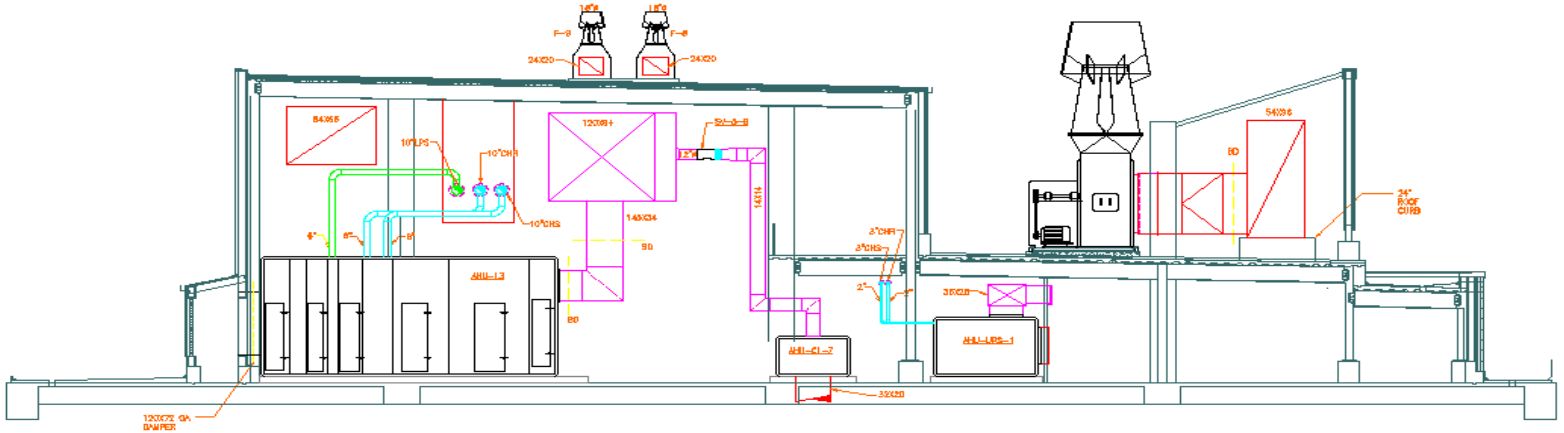
Laboratory Exhaust System (continued)



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System Sizing

System sized to meet peak load

- 16’ tall glass at lab perimeter
- 15 Watts/sf equipment load
- N+1 redundancy

System Capacity

	Room Airflow (CFM)	Fan Airflow (CFM)	System HP
Maximum	170,000	240,000	500
Minimum	103,200	240,000	500

Design Problems

- System is inefficient
- Control issues
- Bypass Air
- Night setback mode
- Fan failure

Design Solutions

Variable Speed Exhaust System

- Significant energy savings
- Simplifies bypass air and night setback control
- Increased reliability with continuous fan operation

Revised System Capacity

	Room Airflow (CFM)	Fan Airflow (CFM)	System HP
Maximum	170,000	240,000	500
Minimum	103,200	240,000	500
Maximum	170,000	170,000	177
Minimum	103,200	120,000	63

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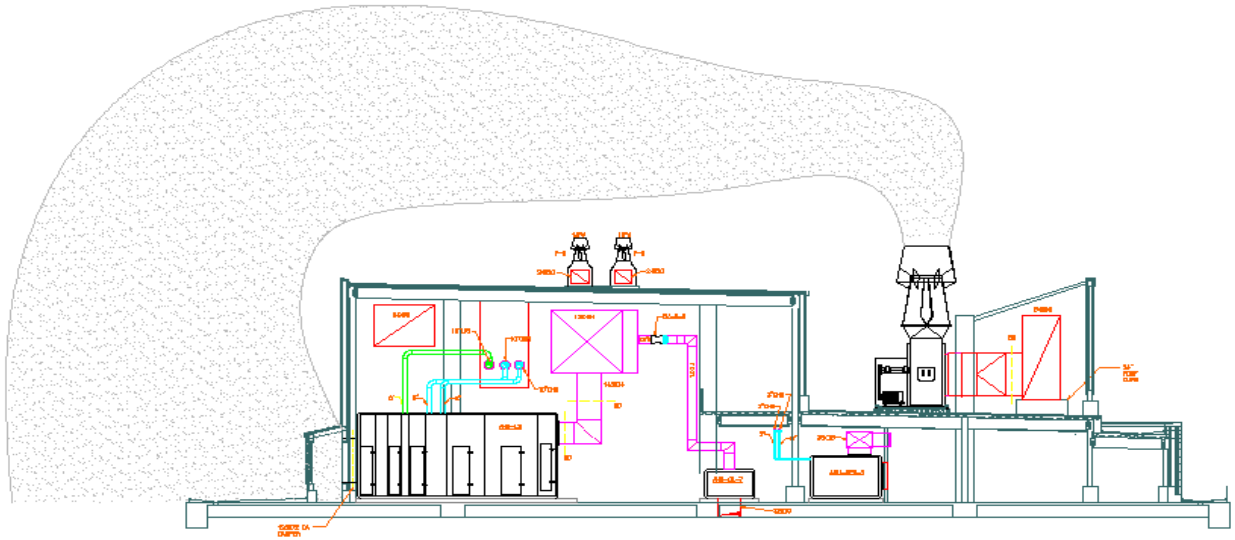
Exhaust Recirculation Issues



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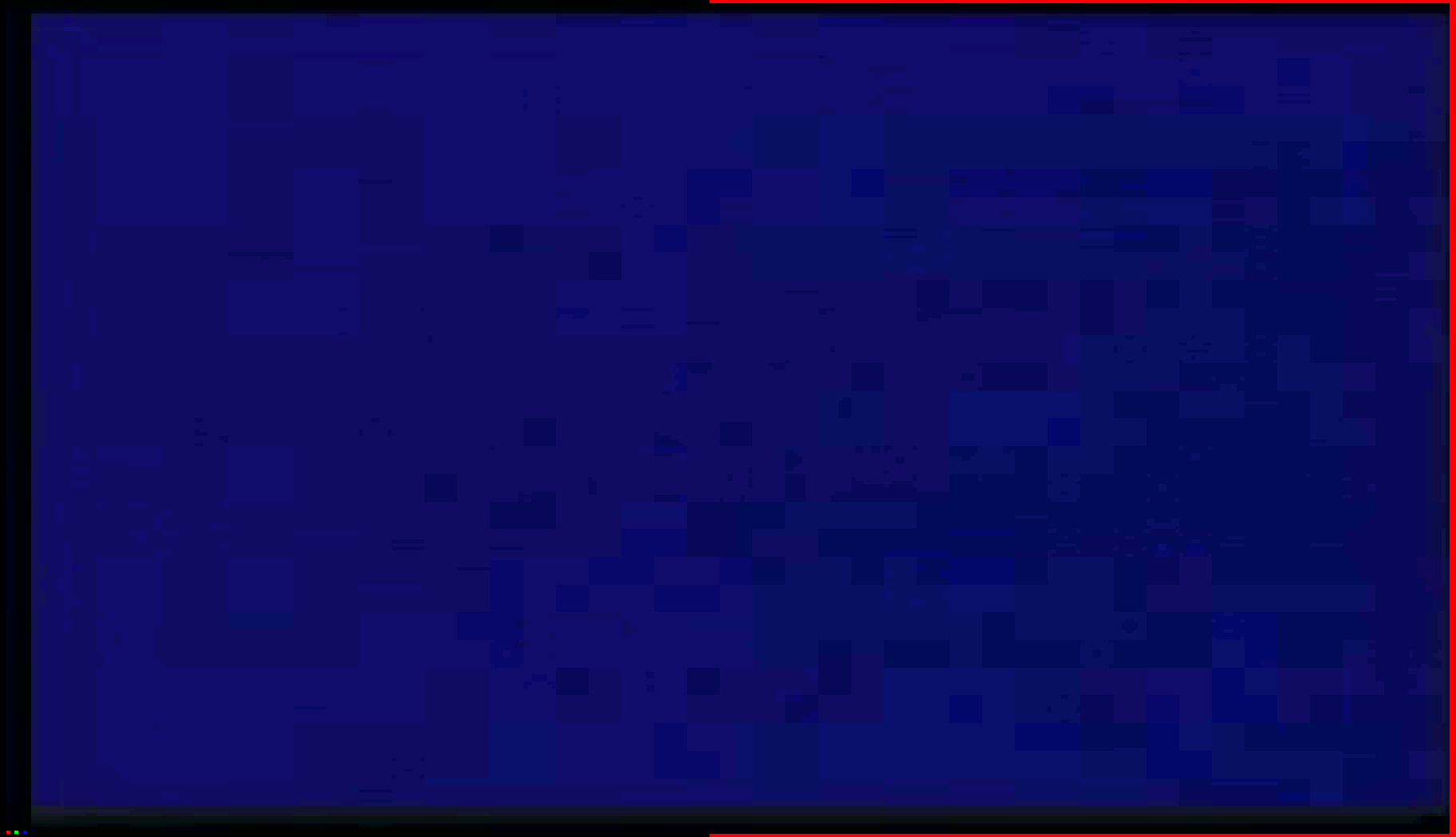
Wind Tunnel



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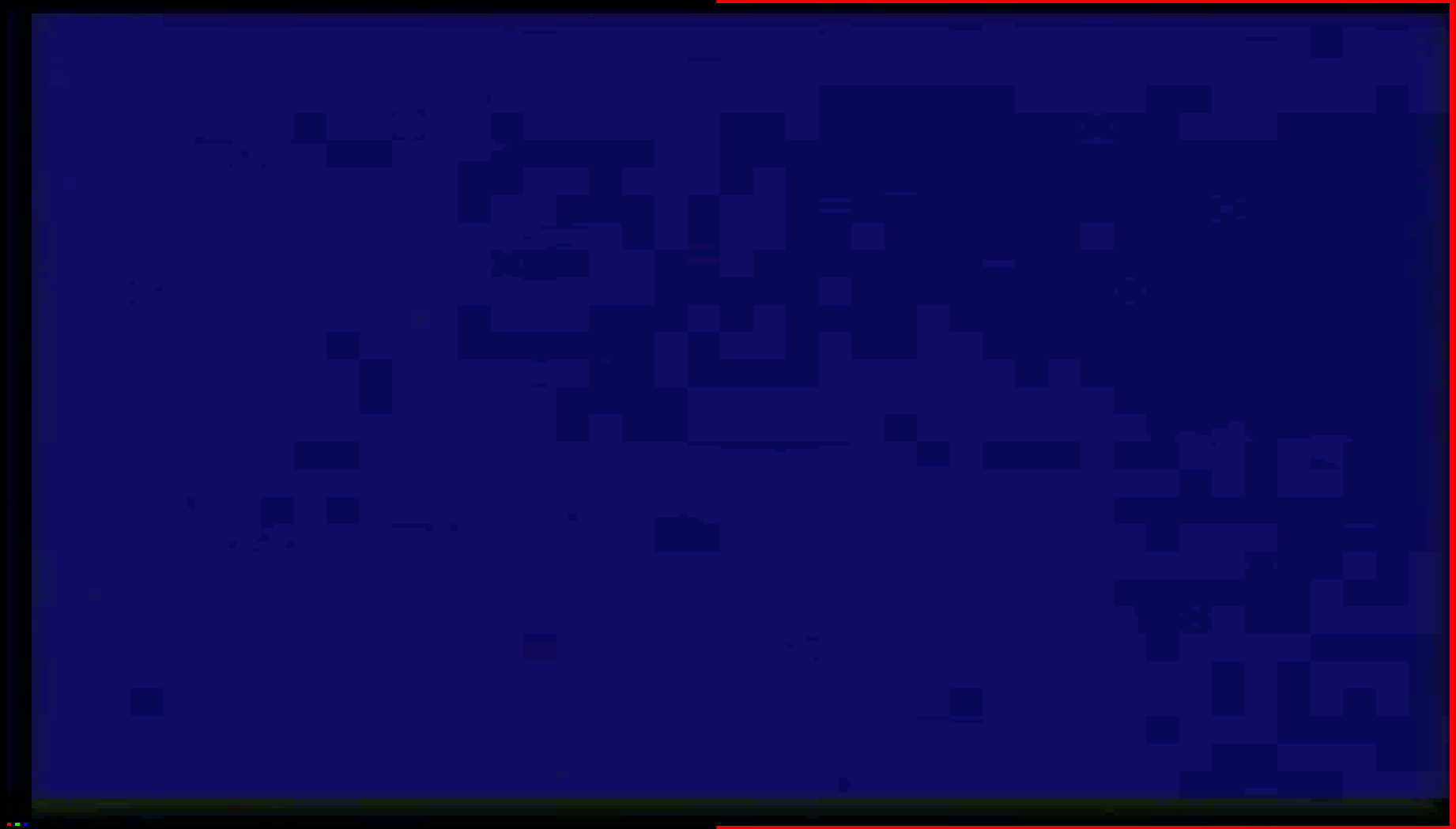
Wind Tunnel



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DOE II Results

To be added

Conclusions

- Varying exhaust discharge velocity may be possible depending on system type
- Significant benefits can be realized with respect to energy use, reliability, and system control
- Not appropriate for all systems and should be carefully analyzed and tested

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Acknowledgements

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Appendices

Appendix A	ANSI/AIHA Z9.5-1992
Appendix B	ASHRAE Fundamentals 2001, Chapter 14, Airflow Around Buildings
Appendix C	Entire Wind Tunnel Testing Video
Appendix D	Case Study for inappropriate use